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Effect of Variation of Different Additives on Green sand Mold Properties for Olivine sand

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Abstract
The quality of castings in a green sand mold is influenced by its properties such as green compression strength, green shear strength, permeability and others. Which are depends on input parameters. The relations of these properties with the input parameters like sand grains size, shape, binder, clay are complex in nature. The evaluation of green sand mold properties has been carried out using different additives. Additives are plays very important role on green sand mold is to enhance specific mold properties. Here Olivine sand have been used for mold purpose. The properties such as compression strength, permeability and collapsibility have been studied, comparison have made with different additives. By conducting number of iterations finally the 7% by volume of water was found the optimal value for the bonding sand and 8% of clay by weight it gives the good bonding strength for the mold .In varying the percentages of additions at 1% of additives the maximum strength was found the optimal fly ash $42.8x10^{-2}N/mm^{2,}$ coconut shell powder$45.3x10^{-2}$ N/mm, and tamarind powder $44.1x10^{-2}$ N/mm^2. The permeability number found in between 0.8 to 1% of additives and others additives also shows the similar trends. Collapsibility index was shows the percentages of additives increases the CI decreases with all other additives. As per AFS the average grain fineness for the sand 45 to 55 have been used for the experimental work.
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Keywords: *Permeability, Collapsibility Index, Clay, Additives,Water. Compressionstrength,*

1. Introduction

Green sand molding is one of the oldest and most popular methods in the world. The aim of the green sand mold is to provide a part with acceptable quality and low cost. The olivine sand have low expansion foundry sand produces the castings with closer dimensional control, better casting accuracy and smoother surface finish. These results are achievable due to olivine unique combination of low uniform thermal expansion and high heat absorption. The molding mixture is composed of sand, adhesive, water, clay etc. The compression strength of sand which is the capability of sand for maintaining sand grains can be measured via compressive and shear strength tests. The compression strength depends on grains shape, size, aggregation of sand, water and additives. The cause of most defects in this method related to mixture. The role of moisture is more than others and the maximum strength and minimal defects in parts can be achieved by knowing the certain amount of moisture and clay(1,2).The composition of molding sand affects the mold properties and thus the quality of the finished castings. Olivine sand improves the activation of clay in green sand systems to maximize bond performance and efficiently produce chemically bonded mold. Eliminate shrinkage in both ferrous and non-ferrous castings. Reduced burn-in penetration defects and lower cleaning casts are achieved.

The research targets study of the influence of additives on sand mold properties for aluminum alloy castings. Three materials were selected for addition to sand mix at weight percentages. These are fly ash, Coconut shell powder and tamarind powder. Sand molding properties were studied. The required tests were made to find the best additives with respect to properties of cast (5).Fly ash it is one of the residues of thermal power station and it is waste material it contents silica this can be utilized as an additives for molding sands. Coconut shell powder, tamarind powder are agricultural waste .The waste is produced in abundance globally and poses risk to health as well as environment. Their effective conduction and eco-friendly utilization has always been a challenge for scientific application. These are used in green sand molding as an additive to improve the surface finish of the casting (8). Permeability is one of the important molding sand properties and considered much in the sand casting preparation. This molding sand property plays a vital role in the sand casting process and helps to remove the gases during the casting process (3, 7). Clay will act as binder mixes

with water to bind the sand particles and can be maintained in the range of 5-7% to produce mold with better refractoriness and higher permeability is lower due to fine clay particles occupied in the available spaces in between the sand grain (4, 6). Sand molds are designed to have a good collapsibility and accommodate shrinkage of cast metal during solidification to avoid defects in the cast metal casting sand should have good flow able to pack well during molding to produce good surface finish as well as exhibition of lower permeability to give better as cast finish (9,10).

2 Materials and Methods

The materials were used in this research are olivine sand from the source of mines and it has been used as basic molding sand. Clay has been used for good bonding purposes, to achieve a specific sand mold properties the different additive has been used in varying percentages with sand and tests carried out for compression strength, Permeability and Collapsibility index for molding sand. The different additives are fly ash, coconut shell powder and tamarind powder are available in plenty in nature .These additives obtained from natural and made as powder as per the required. Fly ash was obtained from the Raichur thermal power station .Tamarind seeds and coconut shell were available in plenty on nature and it is waste .Further was processed and pulverized to make as powder by grinding process as per required particles sizes.

The grain sizes of the olivine sand and the particle sizes of the additives were determined using the AFS specifications.100gram of olivine sand sample was taken and pour in to the top most screens. The sample was shaken for 15minutes by a vibrator. The grains retained on each sieve and the bottom pan were removed and weighed. Finally found the average grain fineness number was 45 to 55 and it has been used for this work. For determination of molding sand properties, known weight of the olivine sand and varying percentages of fly ash, coconut shell powder and tamarind powder (0.2% to 1.4% weight percentages respectively) were used.
7% water by volume and 8% clay by weight has been used throughout the experiment and homogeneous mixed manually and the sand specimen prepared asper AFS. The green compression strength were determined immediately after ramming. In this case the sample was placed between two parallel plates of compressible shackles on the universal sand testing machine. The movement of jaws clamped the sample to fracture in a slow but continuous movement without shock. Permeability was determined by measuring the rate of flow of air through a standard rammers test samples. Standard air pressure was passed through the specimen tube that contained green sand placed in parameter of the permeability metered and the time for 2000cm^{3}of air was recorded to determine permeability in numbers.
Collapsibility Index test was performed with the collapsible tester. The sample was prepared without stripping. The sand test piece was positioned at the top of the tower 1.83m high and ejected from a specimen tube by gently pulling down the handle onto a steel anvil head 75mm in diameter. On impact the test piece collapse, some of the sand remains on the sieve. The sand which passes through the sieve into the sieve pan was weighed and the shatter index was computed.

3 Results and Discussions

The variations of the results shown in terms of graphs. Figure 1 showed the variations of different additives vs. the compression strength for green olivine molding sand. As the percentages of fly ash contents increases the compression strength also increases with increasing additives up to 1% of additives.
At 1% of additives reaches the maximum compression strength. There after increases the percentages of additives the compression strength decreases. This showed that inadequate moisture with increasing additives must have caused the weakening of the compressive strength. Similar trends shows with coconut shell powder and tamarind powder. As compare to all additives the coconut shell powder shows the higher compression strength.
Figure 2. showed with respect to permeability number as the percentages of additives increases the permeability number gradually decreases from 0.4% to 1.2%. This trends shows with all other additives. Higher the percentages of additives contents lower the permeability number. Fly ash shows the good permeability number for molding sand. Further it was observed that the fly ash gives the good permeability number for minimizing defects in castings. This is a result of the fact that due to increased additives caused pores in the mold that will allow gas to pass through during casting.
Figure 3; about the collapsibility index of molding sand.
The collapsibility index decreased with increasing the percentages contents of additives. Fly ash showed that less collapsibility as compare with coconut shell powder and tamarind powder. This showed that with

increasing the additives more tightness of sand grains less permeability and less collapsibility index .More grains remained on the sieve with increased additives content and therefore less collapsibility could be caused by excess additives with the mixture. Heat generated within the mold during casting will burn the excess additives and subsequently resulted in the easy removal of the cast product.

4 Conclusions

The study has examined the role played by different additives on green sand mold properties. Maximum compression strength obtained at 1% of additives contents. The coconut shell powder shows the higher compression strength as compare to fly ash and tamarind powder. Similarly the permeability tests for molding sand fly ash gives a higher permeability number this may be due the coarse particle sizes of the additives. Collapsibility number more grains remained on the sieve with increased additives content and therefore less collapsibility could be caused by excess additives with the mixture. Heat generated within the mold during casting will burn the excess additives and subsequently resulted in the easy removal of the cast product.

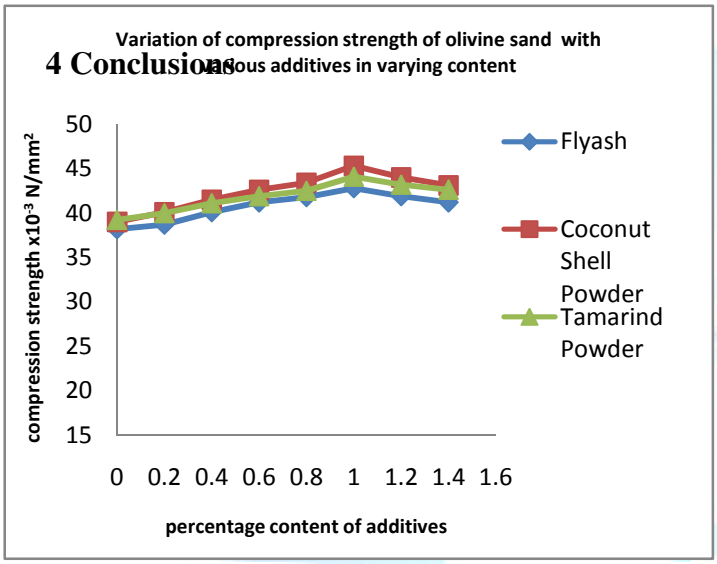

Fig 1: Variation of Compression Strength Vs. Additives

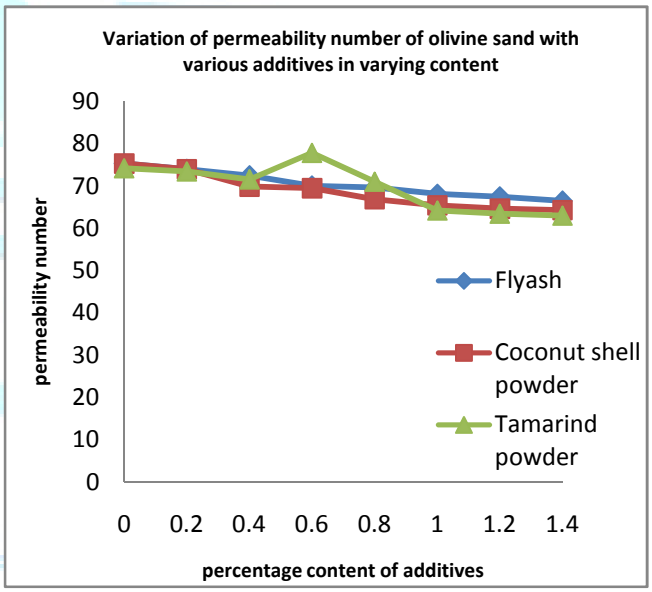

Fig 2: Variation of Permeability Number vs. Additives

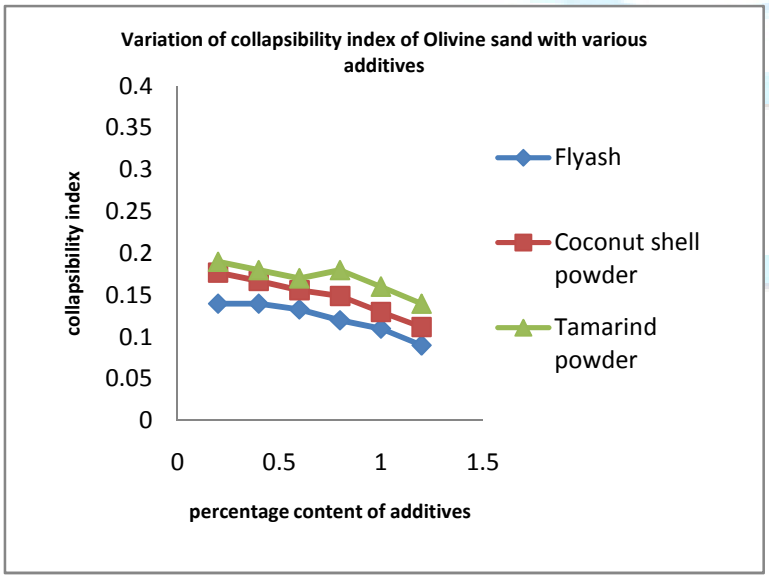

Fig3;Variation of Collapsibility Index Vs Additives.

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